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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Shafer et al.

Serial No. 10/005,732

Filed: November 6, 2001

For: BROAD SPECTRUM ULTRAVIOLET INSPECTION SYSTEMS EMPLOYING CATADIOPTRIC IMAGING

Group Art Unit: 2872
Examiner: Nguyen, T.

Atty. Dkt. No. 5589-00807
P388-3CC

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2-3-04 Pamela Gerik
Date Pamela Gerik

APPEAL BRIEF

Mail Stop Appeal Brief-Patents
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Sir/Madam:

In response to the Notice of Defective Appeal mailed January 12, 2004, further to the Notice of Appeal faxed August 27, 2003 and received in the U.S. Patent and Trademark Office on August 27, 2003, Appellant presents this Appeal Brief. Appellants note that the Appendix which contains the current state of the claims is located on pages 39-41. The Notice of Appeal was filed following mailing of an Advisory Action on August 20, 2003. Appellant hereby appeals to the Board of Patent Appeals and Interferences from a final rejection of claims 21-40 in a Final Office Action mailed June 3, 2003, and respectfully requests that this appeal be considered by the Board.

I. REAL PARTY IN INTEREST

The subject application is owned by KLA-Tencor, Inc., a corporation having a place of business at 160 Rio Robles, San Jose, CA, 95134-1809, as evidenced by the assignment recorded at Reel 012360, Frame 0506.

II. RELATED APPEALS AND INTERFERENCES

No other appeals or interferences are known which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-20 were originally filed in the present application. Claims 1-20 were cancelled in a response filed June 26, 2002 to an Office Action mailed April 26, 2002. Claims 21-45 were added in the same Office Action response. Claims 41-45 were cancelled pursuant to a restriction requirement in a response filed August 19, 2002 to an Office Action mailed July 24, 2002. Claims 21, 29-32, 34, 36, 37, and 39 were amended in a response filed February 28, 2003 to an Office Action mailed October 31, 2002. Claims 46-51 were added in the same Office Action response. Claims 46-51 were withdrawn in a Final Office Action mailed June 3, 2003. Claims 21-40 stand finally rejected under 35 U.S.C. § 103 and 35 U.S.C. § 112, and are the subject of this appeal. A copy of claims 21-40, as on appeal (incorporating entered amendments), is included in the Appendix hereto.

IV. STATUS OF AMENDMENTS

No amendments to the claims have been filed subsequent to their final rejection. The Appendix hereto therefore reflects the current state of the claims.

V. SUMMARY OF THE INVENTION

Appellant's claimed invention relates to a broad band ultraviolet achromatic catadioptric inspection system (Fig. 6). (Specification -- page 4, lines 7-9 and page 5, lines 30-32). The system includes a broad band ultraviolet objective (86) configured to image a first object (82) at a first ultraviolet wavelength and to image a second object at a second ultraviolet wavelength different than the first ultraviolet wavelength. (Specification -- page 18, lines 12-27). The objective includes a first lens (31, Fig. 2) and a second lens (33) having different dispersions. (Specification -- page 8, lines 22-25). The system is configured to detect defects on the first or second object using the image (94, Fig. 6) of the first or second object, respectively. (Specification -- page 17, lines 9-34).

In some embodiments, the first and second objects may be selected from the group consisting of a reticle, a resist, and a semiconductor wafer. (Specification -- page 17, lines 9-17 and page 18, lines 28-31 and lines 35-38). The first and second ultraviolet wavelengths may be selected based on the first and second objects, respectively. (Specification -- page 19, lines 5-11). In one embodiment, the first and second objects may include different materials, and the first and second ultraviolet wavelengths may be selected based on reflectivities of the different materials at different ultraviolet wavelengths. (Specification -- page 18, line 35 - page 19, line 11 and page 5, lines 20-24). In another embodiment, the first or second object may include a reticle, and the first or second ultraviolet wavelength may be an exposure wavelength for which the reticle has been constructed. (Specification -- page 18, lines 28-35). In a different embodiment, the first and second objects may include different resists, and the first and second ultraviolet wavelengths may include about 313 nm and about 220 nm, respectively. (Specification -- page 18, line 35 - page 19, line 11). In other embodiments, the first and second ultraviolet wavelengths may be selected from the group consisting of 193 nm, 248 nm, and 365 nm. (Specification -- page 6, line 38 - page 7, line 20). In some embodiments, the first and second wavelengths may be separated by about 10 nm to about 50 nm. (Specification -- page 20, lines 17-22).

In one embodiment, a field size of the objective may be about 0.5 mm diameter. (Specification -- page 5, lines 12-13). In addition, the objective may have a significantly flattened field. (Specification -- page 5, lines 12-16). In some embodiments, the objective may correct primary and residual longitudinal and lateral color over a wavelength band of at least 20 nm. (Specification -- page 9, lines 9-19). In another embodiment, the objective also includes a focusing lens group (11, Fig. 1) configured to focus ultraviolet light at an intermediate image (13), a field lens group (15) disposed proximate the intermediate image, and a catadioptric relay group (17) configured to form a final image (47) of the intermediate image. (Specification -- page 4, line 22 - page 5, line 11 and page 6, lines 30-38). In such an embodiment, the field lens group may include the first lens and the second lens. (Specification -- page 4, lines 7-21).

In an additional embodiment, the system includes an excimer laser (81, Fig. 5) configured to illuminate the first and second objects (89) with ultraviolet light (85) at the first and second wavelengths, respectively. (Specification -- page 15, lines 3-7). In some embodiments, the objective may be configured to image the first and second objects with light scattered by the first and second objects, respectively. (Specification -- page 5, lines 20-26). In another embodiment, the system may include a ring dark field illumination source configured to illuminate the first and second objects with ultraviolet light at the first and second ultraviolet wavelengths, respectively. (Specification -- page 5, lines 16-20 and page 16, lines 27-34). In a further embodiment, the system may be configured to classify defects and features on the first or second object using the image of the first or second object, respectively. (Specification -- page 5, lines 20-26 and page 19, lines 12-25).

Appellant's claimed invention also relates to another broad band ultraviolet achromatic catadioptric inspection system that includes a broadband ultraviolet light source (61, Fig. 4) configured to illuminate a first object with a first ultraviolet wavelength and to illuminate a second object with a second ultraviolet wavelength different than the first ultraviolet wavelength. (Specification -- page 4, lines 7-9 and page 5, lines 26-35). This system also includes a broad band ultraviolet objective (Fig. 1) configured to image the first object at the first ultraviolet wavelength and to image the second object at the second ultraviolet wavelength. (Specification -

- page 18, lines 12-27). The objective includes a first lens (31, Fig. 2) and a second lens (33) having different dispersions. (Specification -- page 8, lines 22-25). The system is configured to detect defects on the first or second object using the image of the first or second object, respectively. (Specification -- page 17, lines 9-34).

In one embodiment, the light source may include an excimer laser. (Specification -- page 15, lines 3-7). In another embodiment, the first or second object may include a reticle. In such an embodiment, the first or second ultraviolet wavelength is an exposure wavelength for which the reticle has been constructed. (Specification -- page 18, lines 28-35). In a further embodiment, the objective may be configured to image the first and second objects with light scattered by the first and second objects, respectively. (Specification -- page 5, lines 20-26).

VI. ISSUES

1. Whether claims 21-40 are unpatentable under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in a manner as to enable one skilled in the art to make and/or use the invention.

2. Whether claims 21-40 are unpatentable under 35 U.S.C. § 103(a) over U.S. Patent Number 5,031,977 to Gibson. (hereinafter "Gibson").

VII. GROUPING OF CLAIMS

Claims 21, 22, and 27 (Group I) stand or fall together.
Claim 23 (Group II) stands or falls alone.
Claim 24 (Group III) stands or falls alone.
Claims 25, 26, and 28 (Group IV) stand or fall together.
Claim 29 (Group V) stands or falls alone.
Claim 30 (Group VI) stands or falls alone.
Claim 31 (Group VII) stands or falls alone.

Claim 32 (Group VIII) stands or falls alone.

Claim 33 (Group IX) stands or falls alone.

Claim 34 (Group X) stands or falls alone.

Claim 35 (Group XI) stands or falls alone.

Claim 36 (Group XII) stands or falls alone.

Claims 37 and 38 (Group XIII) stand or fall together.

Claim 39 (Group XIV) stands or falls alone.

Claim 40 (Group XV) stands or falls alone.

The reasons why the fifteen groups of claims are believed to be patentable are explained below in the appropriate parts of the Argument.

VIII. ARGUMENT

Catadioptric imaging systems for the deep ultraviolet spectral region are known. These systems employ lens elements of various designs. For example, some systems employ lens elements made from only a single refractive material, namely fused silica, since it is practically the only material that combines good transmission of deep ultraviolet (UV) light with desirable physical properties. *See* Specification: page 1, lines 17-29. However, the lens elements currently used in catadioptric imaging systems have several disadvantages. For example, one lens system corrects for narrow band lateral color, but fails to provide complete correction of residual (secondary and higher order) lateral color over a broad UV spectrum. *See* Specification: page 1, line 30 - page 2, line 27. In a system optimized for use in 0.193 μm wavelength high power excimer laser applications, the dispersion of silica near the 0.193 μm wavelength is great enough that some color correction is still needed. *See* Specification: page 2, line 28 - page 3, line 18. Other systems may completely correct for primary lateral color, but not for residual lateral color. This is the limiting aberration in the system when a broad spectral range is covered. *See* Specification: page 2, lines 19-29.

Therefore, it is desirable to provide a catadioptric imaging system with correction of image aberrations, chromatic variation of image aberrations, longitudinal (axial) color and lateral color, including residual (secondary and higher order) lateral color correction over a broad spectral range in the near and deep ultraviolet spectral band. In addition to color correction, it is also desired to provide a UV imaging system useful as a microscope objective with a large numerical aperture for the final image and with a field of view of at least 0.5mm. *See* Specification: page 3, line 30 - page 4, line 4.

These objects are met with a catadioptric imaging system in which an achromatic multi-element field lens is used, which is made from two or more different refractive materials such as fused silica and fluoride glass. *See* Specification: page 4, lines 7-10. An optical system of the present invention focuses light to an intermediate image with high levels of correction of both image aberrations and chromatic variation of aberrations over a UV wavelength band of at least 0.20 to 0.29 μm, and preferably extending over 0.20 to 0.40 μm. Systems adapted for a UV band that includes the 0.193 μm wavelength are also possible. The system also provides correction of chromatic aberrations including residual axial and lateral color. *See* Specification: page 4, lines 22-35. Furthermore, the system provides a numerical aperture of at least 0.7, a large field size of about 0.5 mm and substantially flat field imaging over a broad wavelength band extending into the deep UV portion of the spectrum. *See* Specification: page 5, lines 12-16. Moreover, UV imaging systems provide not only better optical resolution, but also better material identification due to strong variations in the reflectivity and absorption of UV light by materials, strong scattering, higher orders of diffraction, and fluorescence in the UV spectrum. *See* Specification: page 5, lines 20-26.

Fig. 6 of the Specification shows one embodiment of a wafer inspection apparatus that can use the catadioptric imaging system as a UV objective for the apparatus. Light collected from a die or a portion of a die and formed into a magnified image of that die or portion by the objective is transferred through a relay lens or lens system 90 into the aperture of a video or CCD array camera sensitive to deep UV light. The output of the camera is fed into a data processor, which compares pixel data relating to the UV image of the die or die portion either to data

corresponding to other portions of the image or to stored data from previous images relating to other die or other die portions. The results of this comparison may be fed as data to an output device. *See* Specification: page 17, lines 9-34.

One advantage of the broad band UV objective lens of the present invention with lateral color correction is its large field size of about 0.5 mm diameter, compared to prior narrow band UV lenses that have a field size on the order of 0.1 mm or less. This provides a field with at least 25 times greater area, allowing for high speed inspection of a wafer surface, reticle, or similar object. Inspections that previously took 20 to 30 minutes to complete can now be done in about one minute. The new lens also has a significantly flattened field, which is a must for surface viewing and inspection. Note that no broad band UV objective previously exists. *See* Specification: page 17, line 35 - page 18, line 11.

However, the most important advantage is the objective's multi-wavelength capability. Prior UV objectives are relatively narrow band designs in which good performance is limited to single wavelength sources, because of significant chromatic aberrations over wavelength bands as small as 10 nm in the deep UV (e.g., near 248 nm). In many applications, multi-wavelength sources, such as Xenon flash lamps and arc lamps, are the preferred light source, due to their low cost and absence of coherent artifacts. Such sources demand primary and residual longitudinal color correction over a broader wavelength band of at least 20 nm, and preferably over 100-200 nm wide bands. In other cases, multiple light sources at widely different wavelengths may be used in a single system, again demanding broad band color correction in the UV spectrum. *See* Specification: page 18, lines 12-27.

For a wafer fab facility with both i-line (365 nm) and deep UV 248 nm-based steppers, the broad band UV lens of the present invention enables a reticle inspection system to have selectable i-line or 248 nm wavelength illumination to match the exposure wavelength for which a reticle or mask has been constructed. Such wavelength matching is important, for example, for inspecting advanced phase shifting masks. Likewise, the broad band UV lens of the present invention allows for construction of a system with selectable wavelength for improved inspection

of photoresist on wafers. Photoresist is a material that is transparent to visible light, providing low contrast for inspection at those wavelengths. However, photoresist becomes opaque at the shorter UV wavelengths with different resists becoming opaque at different wavelengths. Thus, wafers with i-line photoresist can be inspected with high sensitivity at a wavelength of about 313 nm, where it is opaque. Wafers with deep UV (248 nm) photoresist can be inspected at a different wavelength around 220 nm. The lens system of the present invention allows the same inspection apparatus to inspect both kinds of photoresist. *See* Specification: page 18, line 28 - page 19, line 11.

In a similar fashion, multiple wavelength imaging of UV light can help in understanding the observed image. For example, different materials vary in their reflectivities at different UV wavelengths. That is, they have what by analogy to color in visible light might be termed "UV color". Most metals other than aluminum become opaque, while silicon becomes more reflective in deep UV light. If combined with a UV camera having a UV photodetector imaging array and a combination of wavelength selective UV transmission filters, the broad band UV objective lens of the present invention can be used to provide a "UV color" image of the object being inspected. This would be useful in defect and feature classification on a wafer. *See* Specification: page 19, lines 12-25.

The UV objective lens of the present invention is useful in many different microscopy techniques, including the previously mentioned bright field, dark field and fluorescence techniques, as well as phase contrast, polarization contrast, differential interference contrast and other techniques. For example, the system may be used in a confocal microscope geometry using a UV lamp and full field imaging instead of a scanning laser device. Some or all of these techniques can be used simultaneously or in sequence within the same objective lens. *See* Specification: page 20, line 32 - page 21, line 4.

ISSUE 1 ARGUMENTS

A. Patentability of Group I-XV Claims 21-40

1. The Specification contains a written description of the invention in full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same.

The Final Office Action mailed June 3, 2003 (PTO Paper No. 11) states:

> The device as claimed in claims 21-40 is directed to an optical system having lens elements and reflective elements. There are two examples concerning the data showing the optical characteristics of the optical elements used to constitute the device being disclosed in the specification as can be seen in pages 13-14. However, the data relating to the optical characteristics of the optical elements disclosed in the lens data contain some questionable problems. (Final Office Action -- pages 3-4).

The Final Office Action further states that "Applicant should note that the use of positive sign and negative sign for (lens/mirrored) surfaces of an optical element must be consistent." (Final Office Action -- page 4). Appellant agrees with the Examiner's assertion that positive and negative signs for surfaces of optical elements must be consistent within a system. Such a reference of positive and negative signs, however, does not necessarily have to follow the direction of the incident light beam as contended in the Final Office Action. The Final Office Action states that "if the surface of an optical element having a convex configuration with respect to the direction of the incident light beam is assigned as a positive sign then the surface of an optical element having a concave configuration with respect to the direction of the incident light beam must be assigned as a negative sign." (Final Office Action -- page 4). Such an assignment of signs may not, however, consistently represent concave and convex configurations of surfaces within a system. As such, in some cases, positive and negative signs may alternatively be assigned to indicate a concave or convex configuration relative to the direction of other optical elements within the system rather than the direction of the incident light beam. In such a case, the spacing between surfaces may be used to indicate the direction of the incident beam of light as shown, for example, in the tables of lens data on pages 13 and 14 of the Specification. In this

manner, the signs attributed with the radii of curvatures may consistently represent either a concave or a convex configuration of surfaces within the system.

2. The sign conventions used in the Specification were known to those of ordinary skill in the art at the time of the invention.

Appellant respectfully asserts that such a representation of data was commonly known by those of ordinary skill in the art in the art at the time of the invention. For example, such a representation of data is included within a previously cited reference, U.S. Patent No. 5,031,976 to Shafer. In particular, U.S. Patent No. 5,031,976 includes a table of lens data in columns 6 and 7, lines 51-69 and lines 1-6, respectively, which includes surfaces #11, #13 and #15 representing the fused silica surface of mirror 50. As shown in the lens data table of U.S. Patent No. 5,031,976, the radius of curvature of surfaces #11, #13 and #15 are each valued at 142.672 mm. Even though the incident light beam approaches surfaces #11, #13 and #15 at different directions, none of the values for surfaces #11, #13 and #15 include a negative sign. Rather, the thickness data corresponding to surfaces #11, #13 and #15 within the lens data table has negative and positive signs which reflect the direction of the incident light beam. As such, the manner in which the lens data for Figs. 2 and 3 are represented on pages 13 and 14 of the presently claimed case is asserted to be known by those skilled in the art. Consequently, it is asserted that the tables of lens data on pages 13 and 14 are shown in a manner as to enable one skilled in the art to make and/or use the invention.

The Final Office Action states that "It is also noted that applicant ahs referred to the Patent No. 5,031,976 to support for the applicant's position relating to the assignment of the signs for optical elements...The Examiner in charge of the present application is not responsible for the correctness of any reference not being examined by the same examiner." (Final Office Action -- page 8). Appellant agrees that the Examiner is not responsible for references not examined by the same Examiner. However, the issued patents referenced herein are provided to show what was known to one skilled in the art at the time of filing the application. Applicant may submit factual affidavits under 37 C.F.R. 1.132 or cite references to show what one skilled in the art knew at the time of filing the application. MPEP 2164.05. The Examiners who

examined U.S. Patent No. 5,031,976 can reasonably be assumed to be persons of ordinary skill in the art. Therefore, such a reference provides a benchmark or an example of what may be considered manners of representing lens data known to those of ordinary skill in the art at the time of filing of the present application. In particular, Primary Examiner Bruce Y. Arnold and Assistant Examiner Martin Lerner, who examined this patent and who may be considered persons of ordinary skill in the art, recognized such a representation of lens data as correct or known to one of ordinary skill in the art.

Furthermore, it is noted that the present application is related to a family of patents that have the same specification. For example, U.S. Patent Nos. 5,717,518 to Shafer et al., 5,956,174 to Shafer et al., 6,133,576 to Shafer et al., and 6,313,467 to Shafer et al. are all related to the present application, and all have the same specification as the present application. Therefore, these issued patents all include the same lens data as that of the Specification of the present application. Primary Examiner Jon W. Henry, Primary Examiner Constantine Hannaher, and Assistant Examiner Andrew Israel conducted the examination of these patents. Since these Examiners can be assumed to be persons of ordinary skill in the art, and since it can be assumed that the Examiners understood the lens data included on pages 13-15 and the illustrations of Figs. 2-4 as enabling description since the lens data was not altered during prosecution, it is asserted that one of ordinary skill in the art would be able to make and/or use the invention based on the description of the invention provided in the Specification.

3. Experimentation needed to practice the invention is not undue or unreasonable.

Appellant respectfully asserts that the lens data in the specification, the detailed description of the lenses, and the detailed drawings of the lens system, in combination, are sufficient to enable one of ordinary skill in the art to make and/or use the invention without undue experimentation. The standard for determining whether the specification meets the enablement requirement was cast in the Supreme Court decision of *Mineral Separation v. Hyde*, 242 U.S. 261, 270 (1916) which postured the question: is the experimentation needed to practice the invention undue or unreasonable? That standard is still the one to be applied. *In re Wands*,

858 F.2d 731, 737, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988). MPEP 2164.01. See also *United States v. Telectronics, Inc.*, 857 F.2d 778, 785, 8 USPQ2d 1217, 1223 (Fed. Cir. 1988) ("The test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation.")

Appellant also respectfully asserts that the lens data in the specification, the detailed description of the lenses, the detailed drawings of the lens system (i.e., the amount of direction provided by the inventor), in combination with the state of the prior art and the level of one of ordinary skill as set forth in more detail above, are sufficient to enable one of ordinary skill in the art to make and/or use the invention without undue experimentation. There are many factors to be considered when determining whether there is sufficient evidence to support a determination that a disclosure does not satisfy the enablement requirement and whether any necessary experimentation is "undue." These factors include, but are not limited to: (A) The breadth of the claims; (B) The nature of the invention; (C) The state of the prior art; (D) The level of one of ordinary skill; (E) The level of predictability in the art; (F) The amount of direction provided by the inventor; (G) The existence of working examples; and (H) The quantity of experimentation needed to make or use the invention based on the content of the disclosure. *In re Wands*, 858 F.2d 731, 737, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988). MPEP 2164.01(a). The examiner's analysis must consider all the evidence related to each of these factors, and any conclusion of nonenablement must be based on the evidence as a whole. 858 F.2d at 737, 740, 8 USPQ2d at 1404, 1407. MPEP 2164.01(a).

Conclusion

As described further above, the subject matter of claims 21-40 is described in the Specification in such a manner that one skilled in the art would be able to make and/or use the invention. For at least these reasons, the rejections of claims 21-40 under 35 U.S.C. § 112, first paragraph, is asserted to be erroneous.

ISSUE 2 ARGUMENTS

A. Patentability of Group I Claims 21, 22, and 27

1. Gibson does not teach or suggest a broad band ultraviolet inspection system that includes a broad band ultraviolet objective configured to image two objects at different wavelengths and that is configured to detect defects on one of the objects using the image of the object.

Claim 21 recites in part: "A broad band ultraviolet achromatic catadioptric inspection system, comprising a broad band ultraviolet objective configured to image a first object at a first ultraviolet wavelength and to image a second object at a second ultraviolet wavelength different than the first ultraviolet wavelength,...wherein the system is configured to detect defects on the first or second object using the image of the first or second object, respectively."

Gibson discloses a deep ultraviolet (UV) lens for use in a photolithography system. However, Gibson does not teach, suggest, or provide motivation for an inspection system which is configured to detect defects on an object using the image of the object. For example, the system of Gibson is a photolithography system. As is known to one of ordinary skill in the art, a photolithography system is incapable of detecting defects on an object. In addition, Gibson does not disclose a broad band ultraviolet system. For example, Gibson states that "Operation of lens 50 to a source of light exposure (desirably in the the [sic] ultraviolet range) is analogous to that as described in the '494 patent identified above." (Gibson -- col. 3, lines 9-11). Therefore, Gibson discloses an ultraviolet system, but not a broad band ultraviolet system. For example, Gibson states that "the present invention of FIG. 3 has...design wavelengths of 249.8 nanometers and 243.8 nanometers." (Gibson -- col. 3, lines 26-29). However, such design wavelengths do not indicate that the objective of Gibson can be used in a broad band ultraviolet system. For instance, the design wavelengths disclosed by Gibson are separated by a mere 6 nm. Such a wavelength range cannot be considered to be a broad band wavelength range, particularly by one of ordinary skill in the art. Therefore, Gibson does not teach or suggest a broad band ultraviolet inspection system that includes a broad band ultraviolet objective configured to image two objects at different wavelengths and that is configured to detect defects on one of the objects using the image of the object, as recited in claim 21.

2. The teachings of Gibson are not sufficient to render the claims *prima facie* obvious.

Assuming, only for the sake of argument, that the system of Gibson may be modified for reticle inspection by placing a detector at the object plane (e.g., object plane 18 shown in Fig. 1 of Gibson), then the detector would be positioned where a wafer would normally be placed in the system. As such, modifying the system of Gibson for inspection would render the system of Gibson unsuitable for photolithography since an image of the reticle could not be formed on the wafer. Instead, the image would be formed on the detector. Therefore, such a modification would change the principle of operation of the invention of Gibson by making the photolithography system incapable of performing photolithography. Consequently, the teachings of Gibson are not sufficient to render the claims *prima facie* obvious. If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810, 123 USPQ 349 (CCPA 1959). MPEP 2143.01.

3. There is no motivation to modify Gibson such that Gibson teaches the limitations of the present claims.

Gibson states that "the present invention is intended to be utilized in a photolithography system for forming patterns on semiconductor wafers." (Gibson -- col. 1, lines 8-10). Gibson also states that "It is an object of the present invention to provide an improved deep ultraviolet (UV) lens for use in a photolithography system." (Gibson -- col. 1, lines 48-50). For at least the reasons provided above, modifying the system of Gibson such that it can inspect an object would render the system of Gibson unable to perform photolithography. Therefore, such a modification would render the invention of Gibson being modified unsatisfactory for its intended purpose (i.e., photolithography). Consequently, there is no suggestion or motivation to modify the system of Gibson such that it is configured to inspect an object. If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). MPEP 2143.01.

4. Gibson does not suggest the desirability of the presently claimed system.

Even if the system of Gibson can be modified such that it can inspect an object, the prior art does not suggest the desirability of such a modification. For example, Gibson does not suggest the desirability of using the system for anything other than photolithography. Instead, Gibson specifically discloses the desirability of using the system for photolithography. For example, Gibson discloses several problems in photolithography applications that the improved deep ultraviolet lens of Gibson overcomes. In particular, Gibson states:

> with increasing demands for higher resolution capabilities from such systems, applicant has recognized a need to modify the system so that even higher numerical apertures and higher resolution may be obtained while maintaining acceptable field size. While the subject matter described in the '494 patent is quite suitable for normal photolithography aspects, such approaches have not provided sufficient capability in deep ultraviolet (UV) photolithography applications. (Gibson -- col. 1, lines 37-45).

In addition, Gibson discloses that the UV lens overcome these problems. For example, Gibson states that "A deep ultraviolet (UV) lens for use in a photolithography system provides enhanced resolution by using shorter wavelengths of light exposure (in the ultraviolet wavelength)." (Gibson -- Abstract). Gibson further states that "the present invention provides for operation in the deep ultraviolet range with a aperture in one embodiment of 0.350." (Gibson -- Abstract). Therefore, Gibson suggests the desirability of incorporating the lens of Gibson into a photolithography system since the lens overcomes problems with prior art photolithography systems. However, Gibson does not suggest the desirability of incorporating the lens into an inspection system. Furthermore, Gibson does not suggest the desirability of modifying the photolithography system such that it can inspect an object. Consequently, such a modification is not obvious. The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). MPEP 2143.01.

5. The Examiner has failed to assign proper patentable weight to structural and functional limitations of the claims.

The Final Office Action states:

> The examiner respectfully disagrees with the applicant's opinion because 1) what kind the system does the claim disclose/recite from the language of the claim(s) in the applicant's viewpoint? and 2) since the presently claims do not recite any specific limitations for the system except the recitation that the system is configured to detect defects and the system and the user/observer in the art of Gibson is a system in a general view/status. (Final Office Action -- page 9).

Although this statement is somewhat unclear to the Appellant, it appears that the Examiner is in doubt as to the "kind" of system that is claimed. As can be clearly seen by claim 21, the "kind" of system that is claimed is an inspection system that is configured to detect defects on an object using an image of the object.

In addition, it appears that the Examiner is asserting that the claims do not recite any specific limitations other than that the system is configured to detect defects on the first or second object using the image of the first or second object, respectfully. If that is the case, Appellant respectfully traverses this assertion. For example, upon reviewing the claims, it should be obvious to the Examiner that the claims include additional limitations which, in combination with the specific feature that "the system is configured to detect defects on the first or second object using the image of the first or second object, respectfully," render the claims patentably distinct over the cited art. In addition, it appears that the Examiner is not giving other limitations of the claim proper patentable weight. For example, the Final Office Action states:

> With regard to the feature concerning the "objective lens" as recited in claims 21 and 37, such feature is not given a patentable weight because all of the features recited in the claims are directed to a formation of two lens elements made by different dispersion and there is not any structural limitations in the inspection system being claimed to determine the set of two lens elements are an objective lens of the inspection system. (Final Office Action -- page 5 - page 6).

However, claim 21 recites in part: "the objective comprises a first lens and a second lens having different dispersions." Therefore, the first and second lenses having different dispersions are clearly included in the claimed objective and therefore form at least a part of the claimed objective.

In addition, the objective is defined by a functional limitation. A functional limitation is an attempt to define something by what it does, rather than by what it is (e.g., as evidenced by its specific structure or specific ingredients). MPEP 2173.05(g). A functional limitation must be evaluated and considered, just like any other limitation of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used. A functional limitation is often used in association with an element, ingredient, or step of a process to define a particular capability or purpose that is served by the recited element, ingredient, or step. MPEP 2173.05(g). It was held that a limitation although functional was perfectly acceptable because it set definite boundaries on the patent protection sought. *In re Barr*, 444 F.2d 588, 170 USPQ 33 (CCPA 1971). MPEP 2173.05(g). Therefore, the claimed objective must be given patentable weight because the objective is defined by a functional limitation ("configured to image") and a structural limitation ("comprises a first lens and a second lens having different dispersions").

Furthermore, it appears that Examiner is asserting that the recitation that the system is configured to detect defects is obvious over Gibson simply because Gibson discloses a system in a "general view/status." However, the limitation that "the system is configured to detect defects on the first or second object using the image" is a functional limitation. As set forth in more detail above, a functional limitation must be evaluated and considered, just like any other limitation of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used. As can be seen from the present claims, the functional limitations set definite boundaries on the patent protection sought (i.e., inspection systems) which do not include the photolithography system of Gibson. In addition, as set forth in more detail above, Gibson does not teach, suggest, or provide motivation for an inspection system configured to detect defects on an object. Therefore, recitation of such a limitation in the present claims is, in fact, a patentable limitation that is not obvious over Gibson.

6. The Examiner has failed to adequately support and/or establish a *prima facie* ground of obviousness.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all claim limitations. MPEP § 2143. None of these three criteria have been met by the Examiner in the present case. First of all, there is no suggestion or motivation to modify the cited references to teach a broad band ultraviolet inspection system that includes a broad band ultraviolet objective configured to image two objects at different wavelengths and that is configured to detect defects on one of the objects using the image of the object, as explained above in Arguments 3 and 4. The criterion of a reasonable expectation of success cannot be met if no teaching, suggestion or motivation exists, because there is then nothing at which to be successful. Finally, the cited art does not teach all of the limitations of claim 21, as explained above in Arguments 1 and 2. The third criterion recited above has therefore also not been met, and a *prima facie* case of obviousness has not been established.

Conclusion

As explained in Arguments 1-6 above, at least some limitations of claim 21 are not taught or suggested by the cited art. There is furthermore no teaching, suggestion, or motivation to modify the cited reference to teach these claim limitations. For at least these reasons, claim 21 is patentably distinct over the cited art. Because claims 22 and 27 are dependent from claim 21, these claims are also patentably distinct over the cited art. Consequently, the rejection of Group I claims 21, 22, and 27 under 35 U.S.C. § 103 is asserted to be erroneous.

B. Patentability of Group II Claim 23

Because claim 23 of Group II is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 23, and are herein incorporated by reference. Claim 23 further recites that the claimed first and second ultraviolet wavelengths are selected based on the claimed first and second objects, respectively. This additional recitation makes claim 23 separately patentable over the cited art, as described in more detail below.

1. Gibson does not teach or suggest that the first and second ultraviolet wavelengths at which first and second objects are imaged are selected based on the first and second objects, respectively.

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson teaches a photolithography system. As is known by one of ordinary skill in the art, photolithography systems are designed for a specific industry-selected wavelength such as 365 nm, 248 nm, or 193 nm. Therefore, the wavelength of the photolithography system of Gibson is selected based on industry-selected wavelengths, not an object being imaged. As such, Gibson does teach or suggest that the first and second ultraviolet wavelengths at which first and second objects are imaged are selected based on the first and second objects, respectively. The claimed first and second wavelengths are, therefore, not taught by the cited art. In addition, there is no teaching, suggestion or motivation to modify Gibson to teach the above limitation of claim 23. Claim 23 is therefore patentable over the cited art, and rejection of claim 23 under 35 U.S.C. § 103 is asserted to be erroneous.

C. Patentability of Group III Claim 24

Because claim 24 of Group III is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 24, and are herein incorporated by reference. Claim 24 further recites that the claimed first and second objects include different materials and that the claimed first and second ultraviolet wavelengths are selected based on reflectivities of the different materials at different ultraviolet wavelengths.

This additional recitation makes claim 24 separately patentable over the cited art, as described in more detail below.

1. **Gibson does not teach or suggest imaging first and second objects that include different materials at first and second ultraviolet wavelengths that are selected based on reflectivities of the different materials at different ultraviolet wavelengths.**

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson teaches a photolithography system. As is known by one of ordinary skill in the art, photolithography systems are designed for a specific industry-selected wavelength such as 365 nm, 248 nm, or 193 nm. In addition, photolithography systems image a reticle onto a wafer. Different reticles designed for use in the same photolithography system generally include the same materials, which are optimized for the wavelength of the photolithography system. Therefore, if the photolithography system of Gibson is used to image two different reticles, the two reticles would generally be formed of the same materials thus having the same reflectivities at different ultraviolet wavelengths. As such, the photolithography system of Gibson does not image objects having different materials.

In addition, the wavelength of the photolithography system of Gibson is selected based on industry-selected wavelengths, not reflectivities of the material of an object at different ultraviolet wavelengths. As a result, Gibson does teach or suggest imaging first and second objects that include different materials at first and second ultraviolet wavelengths that are selected based on reflectivities of the different materials at different ultraviolet wavelengths. The claimed first and second objects and the claimed first and second ultraviolet wavelengths are, therefore, not taught or suggested by the cited art. In addition, there is no teaching, suggestion or motivation to modify Gibson to teach the above limitations of claim 24. Claim 24 is therefore patentable over the cited art, and rejection of claim 24 under 35 U.S.C. § 103 is asserted to be erroneous.

D. Patentability of Group IV Claim 25, 26, and 28

Because claims 25, 26, and 28 of Group IV are dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claims 25, 26, and 28, and are herein incorporated by reference. Claim 25 further recites that the claimed first and second ultraviolet wavelengths are selected from the group consisting of 193 nm, 248 nm, and 365 nm. Claim 26 further recites that the claimed first and second ultraviolet wavelengths are separated by about 10 nm to about 50 nm. Claim 28 further recites that the claimed first and second objects include different resists and that the claimed first and second ultraviolet wavelengths include about 313 nm and about 220 nm, respectively. These additional recitations make claims 25, 26, and 28 separately patentable over the cited art, as described in more detail below.

1. Gibson does not teach or suggest the claimed first and second ultraviolet wavelengths or the claimed first and second objects, as recited in claims 25, 26, and 28.

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson teaches a photolithography system. Gibson states that "the present invention of FIG. 3 has...design wavelengths of 249.8 nanometers and 243.8 nanometers." (Gibson -- col. 3, lines 26-29). However, Gibson does not disclose any of the wavelengths recited in claims 25, 26, and 28. The Final Office Action states that the features recited in claims 25, 26 and 28

> are not critical to the invention by the mutually exclusive of the values of the wavelengths claimed. For instance, while the wavelengths of the claim 25 are selected from a group consisting of 193 nm, 248 nm and 365 nm then the wavelengths of claim 28 are 313 nm and 220 nm, which are both are not in the range or the group of wavelengths recited in claim 25. (Final Office Action -- page 6).

However, claims 25, 26 and 28 are directed toward different embodiments of the presently claimed case and, therefore, are not dependent on each other. Consequently, the claimed values and/or ranges within claims 25, 26 and 28 do not have to nest within each other. Appellant is

unaware of any legal precedent which deems different dependent claim features "non-critical" for being directed toward different embodiments of the invention.

In addition, the features recited in these claims provide significant advantages over the prior art. For example, inspection systems known in the art are generally designed to inspect an object at only one wavelength or at a narrow range of wavelengths. Since the resolution of an inspection system depends on the wavelength of the inspection system (e.g., a shorter wavelength provides greater resolution), an inspection system designed for use at only one or a narrow range of wavelengths provides little flexibility in the objects that it can inspect. For example, an inspection system that is designed to operate at or near 248 nm may not be able to image a resist that was patterned at 193 nm due to the feature sizes of the patterned resist. In addition, it is advantageous to inspect certain objects such as reticles at the wavelengths at which they are to be used. Therefore, inspection systems that are designed to operate at only one or a narrow range of wavelengths may not be suitable for inspection of different types of reticles (e.g., reticles to be used at 248 nm and reticles to be used at 193 nm).

The Final Office Action further states that "it would have been obvious to one skilled in the art to utilize any kind of light sources whose wavelengths are in the range of deep ultraviolet for an exposure process from a reticle to a wafer using the lens system provided by Gibson to obtain a good resolution due to the different materials of the lens elements." (Final Office Action -- page 6). Appellant respectfully traverses this assertion.

For example, the wavelength of light that is used by a photolithography system is not determined by the materials of the lens elements. Instead, as is known to one of ordinary skill in the art, there are certain industry agreed upon wavelengths (e.g., 193 nm, 248 nm, 365 nm, etc.) at which resists and corresponding exposure tools are developed. Such agreed upon wavelengths are necessary such that different companies can work toward producing resists and photolithography systems that can be used together at a common wavelength. Otherwise, the resists and the photolithography systems will be useless.

However, as is known to one of ordinary skill in the art, photolithography systems are designed for only one of these ultraviolet wavelengths. For example, a photolithography system that is designed for 248 nm cannot be used for 193 nm since each optical component of the photolithography system (e.g., light source, condenser lens, objective lens, reticle, aperture, degree of coherence, etc.) varies depending on the wavelength. For example, a lens that is used in a 248 nm photolithography system may be significantly damaged in a 193 nm photolithography system thereby resulting in failure of the photolithography system.

Gibson discloses that the system can use two wavelengths, 243.8 and 249.8. Therefore, it is not obvious that the photolithography system of Gibson can be used at the other claimed wavelengths since it is known to one of ordinary skill in the art that photolithography systems are designed for one target ultraviolet wavelength and that photolithography systems can only be used for that target wavelength. In addition, as is known to one of ordinary skill in the art, photolithography systems for different wavelengths are substantially different (different light sources, different lenses, different lens materials, different numerical apertures, different reticles, different reticle materials, etc.) and can take years to design and develop. There is, therefore, absolutely no reasonable expectation of success that the system of Gibson can be used at wavelengths other than those disclosed by Gibson. Consequently, Gibson cannot be modified to reject claims 25, 26, and 28 as *prima facie* obvious. The prior art can be modified or combined to reject claims as *prima facie* obvious as long as there is a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). MPEP 2143.02. Evidence showing there was no reasonable expectation of success may support a conclusion of nonobviousness. *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CPA 1976). MPEP 2143.02. Consequently, the features of claims 25, 26, and 28 are not taught or suggested by the cited art. In addition, there is no teaching, suggestion, or motivation to modify Gibson to teach the above limitations of claims 25, 26, and 28. Claims 25, 26, and 28 are therefore patentable over the cited art, and rejection of claims 25, 26, and 28 under 35 U.S.C. § 103 is asserted to be erroneous.

E. Patentability of Group V Claim 29

Because claim 29 of Group V is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 29, and are herein incorporated by reference. Claim 29 further recites that a field size of the claimed objective is about 0.5 mm diameter. This additional recitation makes claim 29 separately patentable over the cited art, as described in more detail below.

1. Gibson does not teach or suggest an objective that has a field size of about 0.5 mm diameter.

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson discloses an objective designed for used in a photolithography system. Gibson does not disclose a field size for the objectives described therein. In fact, it appears that the intention of Gibson is to create a photolithography system which maintains field size in a range which is commensurate with prior systems. For example, Gibson states that "with increasing demands for higher resolution capabilities from such systems, applicant has recognized a need to modify the system so that even higher numerical apertures and higher resolution may be obtained while maintaining acceptable field size." (Gibson -- col. 1, lines 37-41). As such, one skilled in the art may presume that the field size of the objectives taught by Gibson would be substantially similar to those of prior art objectives, absent any teaching or suggestion otherwise. The presently claimed case discloses that "prior narrow band UV lenses [to] have a field size on the order of 0.1 mm or less." (Specification -- pages 17-18, lines 38 and 1, respectively). As such, one skilled in the art may presume that the field size of the objectives taught by Gibson would be approximately 0.1 mm or less. As such, Gibson does teach or suggest an objective that has a field size of about 0.5 mm diameter. The claimed field size of the objective is therefore not taught or suggested by the cited art. Claim 29 is therefore patentable over the cited art, and rejection of claim 29 under 35 U.S.C. § 103 is asserted to be erroneous.

F. Patentability of Group VI Claim 30

Because claim 30 of Group VI is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 30, and are herein incorporated by reference. Claim 30 further recites that the claimed objective has a significantly flattened field. This additional recitation makes claim 30 separately patentable over the cited art, as described in more detail below.

1. Gibson does not teach or suggest an objective that has a significantly flattened field.

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson teaches an objective designed for use in a photolithography system. However, Gibson does not teach or suggest that the objective has a flat field or how flat the field of the objective is. As such, Gibson does not teach or suggest an objective that has a significantly flattened field. The claimed objective is therefore not taught or suggested by the cited art. Claim 30 is therefore patentable over the cited art, and rejection of claim 30 under 35 U.S.C. § 103 is asserted to be erroneous.

G. Patentability of Group VII Claim 31

Because claim 31 of Group VII is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 31, and are herein incorporated by reference. Claim 31 further recites that the claimed objective corrects primary and residual longitudinal and lateral color over a wavelength band of at least 20 nm. This additional recitation makes claim 31 separately patentable over the cited art, as described in more detail below.

1. Gibson does not teach or suggest an objective that corrects primary and residual longitudinal and lateral color over a wavelength band of at least 20 nm.

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson discloses an objective designed for use in a photolithography system. Gibson states that "The present invention provides a combination of components as seen in Fig. 3, which transmits a light source in the deep ultraviolet range at the proper wavelength and color and aberration correction." (Gibson -- col. 2, line 67 - col. 3, line 2). In addition, Gibson states that "the present invention of FIG. 3 has...design wavelengths of 249.8 nanometers and 243.8 nanometers." (Gibson -- col. 3, lines 26-29). Therefore, although the system of Gibson may transmit light at the proper wavelength and color and aberration correction over a wavelength band of 6 nm (from 249.8 nm to 243.8 nm), Gibson does not teach or suggest an objective that corrects primary and residual longitudinal and lateral color over a wavelength band of at least 20 nm. The claimed objective is therefore not taught or suggested by the cited art. Claim 31 is therefore patentable over the cited art, and rejection of claim 31 under 35 U.S.C. § 103 is asserted to be erroneous.

H. Patentability of Group VIII Claim 32

Because claim 32 of Group VIII is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 32, and are herein incorporated by reference. Claim 32 further recites that the claimed objective includes a focusing lens group configured to focus ultraviolet light at an intermediate image, a field lens group disposed proximate the intermediate image, which includes the claimed first and second lenses, and a catadioptric relay group configured to form a final image of the intermediate image. This additional recitation makes claim 32 separately patentable over the cited art, as described in more detail below.

1. **Gibson does not teach or suggest an objective that includes a focusing lens group configured to focus ultraviolet light at an intermediate image, a field lens group disposed proximate the intermediate image, which includes first and second lenses having different dispersions, and a catadioptric relay group configured to form a final image of the intermediate image.**

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson discloses an objective designed for use in a photolithography system. Gibson states that "lens 50 includes a first mirror 52 and a meniscus 54 which is desirably of fused silica. The lens 50 of FIG. 3 also includes a plano-convex lens 56, desirably of lithium fluoride, and a pair of optical elements 60-1, 60-2 (desirably prisms) which are of calcium fluoride." (Gibson -- col. 3, lines 3-8). Therefore, as shown in Fig. 3 of Gibson, Gibson appears to teach that the objective includes a single catadioptric group of lenses. As such, Gibson does not teach or suggest a focusing lens group or a field lens group as presently claimed. Gibson also states that "Operation of lens 50 to a source of light exposure (desirably in the the [sic] ultraviolet range) is analogous to that as described in the '494 patent identified above." (Gibson -- col. 3, lines 9-11). As shown in Fig. 1 of Gibson, the lens is used to focus light onto a reticle and then to image light reflected from the reticle onto a wafer. However, it does not appear that the lens of Gibson forms an intermediate image. Therefore, Gibson does not teach or suggest the objective, as recited in claim 32. Claim 32 is therefore patentable over the cited art, and rejection of claim 32 under 35 U.S.C. § 103 is asserted to be erroneous.

I. Patentability of Group IX Claim 33

Because claim 33 of Group IX is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 33, and are herein incorporated by reference. Claim 33 further recites that the claimed system also includes an excimer laser configured to illuminate the first and second objects with ultraviolet light at the first and second ultraviolet wavelengths, respectively. This additional recitation makes claim 33 separately patentable over the cited art, as described in more detail below.

1. **Gibson does not teach or suggest an inspection system that includes an excimer laser configured to illuminate first and second objects with ultraviolet light at first and second ultraviolet wavelengths, respectively.**

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson discloses an objective lens that is designed for use in a photolithography system. Gibson states that "Operation of lens 50 to a source of light exposure (desirably in the the [sic] ultraviolet range) is analogous to that as described in the '494 patent identified above." (Gibson -- col. 3, lines 9-11). Therefore, Gibson discloses that the objective may be used with an ultraviolet light source. Many different light sources may produce ultraviolet light. Therefore, by disclosing only that the light source is an ultraviolet light source, Gibson does not disclose any particular ultraviolet light source. As such, Gibson does not teach or suggest an inspection system that includes an excimer laser configured to illuminate first and second objects with ultraviolet light at first and second ultraviolet wavelengths, respectively. Therefore, Gibson does not teach or suggest the limitations recited in claim 33. Claim 33 is therefore patentable over the cited art, and rejection of claim 33 under 35 U.S.C. § 103 is asserted to be erroneous.

J. Patentability of Group X Claim 34

Because claim 34 of Group X is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 34, and are herein incorporated by reference. Claim 34 further recites that the claimed objective is further configured to image the first and second objects with light scattered by the first and second objects, respectively. This additional recitation makes claim 34 separately patentable over the cited art, as described in more detail below.

1. **Gibson does not teach or suggest an objective that is configured to image first and second objects with light scattered by the first and second objects, respectively.**

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson discloses an objective lens that is designed for use in a photolithography system. An

objective that images objects with light scattered from the objects, as presently claimed, may be advantageous for an inspection system. For example, such a feature is advantageous since an image of an object that is formed with light scattered by the object will allow detection of defects having smaller dimensions than those which may be detected using bright field imaging. The Final Office Action states:

> With regard to the features concerning the scattered light from the objects... such features are clearly inherent from the system provided by Gibson without any specific limitations recited in the present claims. In particular, since the reticle comprises different areas and the different areas are illuminated to form images in a wafer; therefore, any scattered light from the reticle will be guide/imaged onto the wafer. (Final Office Action -- page 6).

Appellant respectfully traverses this assertion. For example, Gibson only discloses a photolithography system. As is known to one of ordinary skill in the art, photolithography systems are specifically designed to minimize the amount of light scattered from the reticle that reaches the wafer since any scattered light that reaches the wafer during exposure will adversely alter the image formed on the wafer by, for example, reducing the contrast of the image, which in turn will reduce the resolution of the image. For instance, photolithography systems are generally designed to have numerical apertures that prevent light scattered from the reticle from reaching the wafer. The numerical aperture of a photolithography system may be selected such that the scattered light falls outside of the aperture and therefore is not directed to the wafer. As such, Gibson does not teach or suggest an objective that is configured to image first and second objects with light scattered by the first and second objects, respectively. Therefore, Gibson does not teach or suggest an objective as recited in claim 34. Claim 34 is therefore patentable over the cited art, and rejection of claim 34 under 35 U.S.C. § 103 is asserted to be erroneous.

K. Patentability of Group XI Claim 35

Because claim 35 of Group XI is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 35, and are herein incorporated by reference. Claim 35 further recites that the claimed system also includes a ring dark field illumination source configured to illuminate the first and second objects with

ultraviolet light at the first and second ultraviolet wavelengths, respectively. This additional recitation makes claim 35 separately patentable over the cited art, as described in more detail below.

1. **Gibson does not teach or suggest an inspection system that includes a ring dark field illumination source configured to illuminate the first and second objects with ultraviolet light at the first and second ultraviolet wavelengths, respectively.**

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson discloses an objective lens that is designed for use in a photolithography system. Gibson states that "Operation of lens 50 to a source of light exposure (desirably in the the [sic] ultraviolet range) is analogous to that as described in the '494 patent identified above." (Gibson -- col. 3, lines 9-11). Therefore, Gibson discloses that the objective may be used with an ultraviolet light source. Many different light sources may produce ultraviolet light. Therefore, by disclosing only that the light source is an ultraviolet light source, Gibson does not disclose any particular ultraviolet light source. As such, Gibson does not teach or suggest an inspection system that includes a ring dark field illumination source configured to illuminate the first and second objects with ultraviolet light at the first and second ultraviolet wavelengths, respectively, as recited in claim 35. Claim 35 is therefore patentable over the cited art, and rejection of claim 35 under 35 U.S.C. § 103 is asserted to be erroneous.

L. Patentability of Group XII Claim 36

Because claim 36 of Group XII is dependent from claim 21 of Group I, the arguments presented above for patentability of claim 21 apply equally to claim 36, and are herein incorporated by reference. Claim 36 further recites that the claimed system is further configured to classify defects and features on the first or second object using the image of the first or second object, respectively. This additional recitation makes claim 36 separately patentable over the cited art, as described in more detail below.

1. **Gibson does not teach or suggest an inspection system that is configured to classify defects and features on a first or second object using an image of the first or second object, respectively.**

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson does not teach, suggest, or provide motivation for an inspection system configured to detect defects on a first or second object using an image of the first or second object. The Final Office Action states that "The classification of the defects/features of the different areas of the reticle is also recognized/observed by a user during the process of exposure the reticle to ultraviolet light." (Final Office Action -- page 6 - page 7). Assuming for the sake of argument that a user of the system of Gibson could classify defects on a wafer, there is still no teaching or suggestion in the art that the system of Gibson could be configured for such classification. As such, Gibson does not teach or suggest an inspection system that is configured to classify defects and features on a first or second object using an image of the first or second object, respectively. In addition, the limitation of claim 36 is a functional limitation. As discussed further with respect to the patentability of Group I claims 21, 22, and 27, a functional limitation must be evaluated and considered, just like any other claim, and are acceptable because it sets definite boundaries on the patent protection sought. Therefore, recitation of such a limitation in claim 36 is, in fact, a patentable limitation that is not obvious over Gibson. Therefore, Gibson does not teach all limitations recited in claim 36. Claim 36 is therefore patentable over the cited art, and rejection of claim 36 under 35 U.S.C. § 103 is asserted to be erroneous.

M. Patentability of Group XIII Claims 37 and 38

1. **Gibson does not teach or suggest a broad band ultraviolet inspection system that includes a broadband ultraviolet light source configured to illuminate a first object with a first ultraviolet wavelength and to illuminate a second object with a second ultraviolet wavelength different than the first ultraviolet wavelength.**

Claim 37 recites in part: "A broad band ultraviolet achromatic catadioptric inspection system, comprising: a broadband ultraviolet light source configured to illuminate a first object with a first ultraviolet wavelength and to illuminate a second object with a second ultraviolet wavelength different than the first ultraviolet wavelength."

As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, Gibson discloses an objective that is designed for use in a photolithography system. For example, Gibson states that "Operation of lens 50 to a source of light exposure (desirably in the the [sic] ultraviolet range) is analogous to that as described in the '494 patent identified above." (Gibson -- col. 3, lines 9-11). Gibson also states that "the present invention of FIG. 3 has...design wavelengths of 249.8 nanometers and 243.8 nanometers." (Gibson -- col. 3, lines 26-29). Therefore, Gibson discloses that the objective may be operated with an ultraviolet light source. In addition, Gibson discloses that the objective has design wavelengths of 249.8 nm and 243.8 nm. Gibson, however, does not disclose that one light source is used to provide both wavelengths of light. Furthermore, assuming, only for the sake of argument, that both 249.8 nm and 243.8 nm of light could be produced with one light source, such a range of wavelengths (6 nm) would in no way be considered a broadband wavelength range by one of ordinary skill in the art. Therefore, Gibson does not teach or suggest a broad band ultraviolet inspection system that includes a broadband ultraviolet light source configured to illuminate a first object with a first ultraviolet wavelength and to illuminate a second object with a second ultraviolet wavelength different than the first ultraviolet wavelength, as recited in claim 37.

2. Gibson does not suggest the desirability of the claimed broad band ultraviolet inspection system.

Even if the system of Gibson can be modified such that it can operate in a broad band ultraviolet range, the prior art does not suggest the desirability of such a modification. In particular, Gibson states that "While the subject matter described in the '494 patent is quite suitable for normal photolithography aspects, such approaches have not provided sufficient capability in deep ultraviolet (UV) photolithography applications." (Gibson -- col. 1, lines 37-45). Gibson also states that "It is an object of the present invention to provide an improved deep ultraviolet (UV) lens for use in a photolithography system." (Gibson -- col. 1, lines 48-50). Therefore, Gibson suggests the desirability of designing a lens for use in the deep ultraviolet range. However, Gibson does not suggest the desirability of designing a lens for use in a broad band ultraviolet range. In addition, Gibson does not suggest the desirability of using the system for anything other than deep ultraviolet photolithography applications. For example, Gibson

does not suggest the desirability of modifying the photolithography system such that it can detect defects on an object. Consequently, even if the invention of Gibson could be modified to teach all limitations of the present claims, such modifications are not obvious. The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). MPEP 2143.01.

3. Gibson does not teach or suggest a broad band ultraviolet inspection system that includes a broad band ultraviolet objective configured to image two objects at different wavelengths and that is configured to detect defects on one of the objects using the image of the object.

Claim 37 recites in part: "A broad band ultraviolet achromatic catadioptric inspection system, comprising:...a broad band ultraviolet objective configured to image the first object at the first ultraviolet wavelength and to image the second object at the second ultraviolet wavelength,...wherein the system is configured to detect defects on the first or second object using the image of the first or second object, respectively."

Claim 21 of Group I recites a similar limitation. Therefore, the arguments presented above for patentability of claim 21 apply equally to claim 37, and are herein incorporated by reference. As discussed further above with respect to the patentability of Group I claims 21, 22, and 27, 1) Gibson does not teach or suggest a broad band ultraviolet inspection system that includes a broad band ultraviolet objective configured to image two objects at different wavelengths and that is configured to detect defects on one of the objects using the image of the object; 2) the teachings of Gibson are not sufficient to render these limitations of the claims *prima facie* obvious; 3) there is no motivation to modify Gibson such that Gibson teaches the limitations of the present claims; 4) Gibson does not suggest the desirability of the claimed system; and 5) the Examiner has failed to assign proper patentable weight to structural and functional limitations of the claims. Therefore, Gibson does not teach or suggest a broad band ultraviolet inspection system that includes a broad band ultraviolet objective configured to image two objects at different wavelengths and that is configured to detect defects on one of the objects using the image of the object, as recited in claim 37.

4. The Examiner has failed to adequately support and/or establish a *prima facie* ground of obviousness.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all claim limitations. MPEP § 2143. None of these three criteria have been met by the Examiner in the present case. First of all, there is no suggestion or motivation to modify the cited references to teach a broad band ultraviolet inspection system that includes a broadband ultraviolet light source configured to illuminate a first object with a first ultraviolet wavelength and to illuminate a second object with a second ultraviolet wavelength different than the first ultraviolet wavelength or a broad band ultraviolet inspection system that includes a broad band ultraviolet objective configured to image two objects at different wavelengths and that is configured to detect defects on one of the objects using the image of the object, as explained above in Arguments 2 and 3. The criterion of a reasonable expectation of success cannot be met if no teaching, suggestion or motivation exists, because there is then nothing at which to be successful. Finally, the cited art does not teach all of the limitations of claim 37, as explained above in Arguments 1 and 3. The third criterion recited above has therefore also not been met, and a *prima facie* case of obviousness has not been established.

Conclusion

As explained in Arguments 1-4 above, at least some limitations of claim 37 are not taught or suggested by the cited art. There is furthermore no teaching, suggestion or motivation to modify the cited reference to teach these claim limitations. For at least these reasons, claim 37 is patentably distinct over the cited art. Because claim 38 is dependent from claim 37, this claim is also patentably distinct over the cited art. Consequently, the rejection of Group XIII claims 37 and 38 under 35 U.S.C. § 103 is asserted to be erroneous.

N. Patentability of Group XIV Claim 39

Because claim 39 of Group XIV is dependent from claim 37 of Group XIII, the arguments presented above for patentability of claim 37 apply equally to claim 39, and are herein incorporated by reference. Claim 39 further recites that the claimed objective is further configured to image the first and second objects with light scattered by the first and second objects, respectively. This additional recitation makes claim 39 separately patentable over the cited art, as described in more detail below.

1. Gibson does not teach or suggest an objective that is configured to image first and second objects with light scattered by the first and second objects, respectively.

Claim 34 of Group X recites a similar limitation. Therefore, the arguments presented above for patentability of claim 34 apply equally to claim 39, and are herein incorporated by reference. As discussed further above with respect to the patentability of Group X claim 34, 1) an objective that images objects with light scattered from the objects, as presently claimed, may be advantageous for an inspection system; 2) Gibson only discloses a photolithography system, which as is known to one of ordinary skill in the art, is designed to minimize the amount of light scattered from the reticle that reaches the wafer since any scattered light that reaches the wafer during exposure will adversely alter the image formed on the wafer; and therefore 3) photolithography systems are generally designed to have numerical apertures that prevent light scattered from the reticle from reaching the wafer. As such, Gibson does not teach or suggest an objective that is configured to image first and second objects with light scattered by the first and second objects, respectively. Therefore, Gibson does not teach or suggest an objective, as recited in claim 39. Claim 39 is therefore patentable over the cited art, and rejection of claim 39 under 35 U.S.C. § 103 is asserted to be erroneous.

O. Patentability of Group XV Claim 40

Because claim 40 of Group XV is dependent from claim 37 of Group XIII, the arguments presented above for patentability of claim 37 apply equally to claim 40, and are herein incorporated by reference. Claim 40 further recites that the claimed light source includes an excimer laser. This additional recitation makes claim 40 separately patentable over the cited art, as described in more detail below.

1. Gibson does not teach or suggest an inspection system that includes an excimer laser as a light source.

Claim 33 of Group IX recites a similar limitation. Therefore, the arguments presented above for patentability of claim 33 apply equally to claim 40, and are herein incorporated by reference. As discussed further above with respect to the patentability of Group IX claim 33, Gibson discloses an objective lens that is designed for use in a photolithography system. In addition, Gibson discloses that the objective may be used with an ultraviolet light source. However, many different light sources may produce ultraviolet light. Therefore, by disclosing only that the light source is an ultraviolet light source, Gibson does not disclose any particular ultraviolet light source. As such, Gibson does not teach or suggest an inspection system that includes an excimer laser as a light source, as recited in claim 40. Claim 40 is therefore patentable over the cited art, and rejection of claim 40 under 35 U.S.C. § 103 is asserted to be erroneous.

IX. CONCLUSION

For the foregoing reasons, it is submitted that the Examiner's rejection of claims 21-40 was erroneous, and reversal of the Examiner's decision is respectfully requested.

The Commissioner is hereby authorized to charge the required fee(s) to Conley Rose, P.C. deposit account 03-2769/5589-00807.

Respectfully submitted,

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X. APPENDIX

The present claims on appeal are as follows.

21. A broad band ultraviolet achromatic catadioptric inspection system, comprising a broad band ultraviolet objective configured to image a first object at a first ultraviolet wavelength and to image a second object at a second ultraviolet wavelength different than the first ultraviolet wavelength, wherein the objective comprises a first lens and a second lens having different dispersions, and wherein the system is configured to detect defects on the first or second object using the image of the first or second object, respectively.

22. The system of claim 21, wherein the first and second objects are selected from the group consisting of a reticle, a resist, and a semiconductor wafer.

23. The system of claim 21, wherein the first and second ultraviolet wavelengths are selected based on the first and second objects, respectively.

24. The system of claim 21, wherein the first and second objects comprise different materials, and wherein the first and second ultraviolet wavelengths are selected based on reflectivities of the different materials at different ultraviolet wavelengths.

25. The system of claim 21, wherein the first and second ultraviolet wavelengths are selected from the group consisting of 193 nm, 248 nm, and 365 nm.

26. The system of claim 21, wherein the first and second ultraviolet wavelengths are separated by about 10 nm to about 50 nm.

27. The system of claim 21, wherein the first or second object comprises a reticle, and wherein the first or second ultraviolet wavelength is an exposure wavelength for which the reticle has been constructed.

28. The system of claim 21, wherein the first and second objects comprise different resists, and wherein the first and second ultraviolet wavelengths comprise about 313 nm and about 220 nm, respectively.

29. The system of claim 21, wherein a field size of the objective is about 0.5 mm diameter.

30. The system of claim 21, wherein the objective has a significantly flattened field.

31. The system of claim 21, wherein the objective corrects primary and residual longitudinal and lateral color over a wavelength band of at least 20 nm.

32. The system of claim 21, wherein the objective further comprises a focusing lens group configured to focus ultraviolet light at an intermediate image, a field lens group disposed proximate the intermediate image, wherein the field lens group comprises the first lens and the second lens, and a catadioptric relay group configured to form a final image of the intermediate image.

33. The system of claim 21, further comprising an excimer laser configured to illuminate the first and second objects with ultraviolet light at the first and second ultraviolet wavelengths, respectively.

34. The system of claim 21, wherein the objective is further configured to image the first and second objects with light scattered by the first and second objects, respectively.

35. The system of claim 21, further comprising a ring dark field illumination source configured to illuminate the first and second objects with ultraviolet light at the first and second ultraviolet wavelengths, respectively.

36. The system of claim 21, wherein the system is further configured to classify defects and features on the first or second object using the image of the first or second object, respectively.

37. A broad band ultraviolet achromatic catadioptric inspection system, comprising:

a broadband ultraviolet light source configured to illuminate a first object with a first ultraviolet wavelength and to illuminate a second object with a second ultraviolet wavelength different than the first ultraviolet wavelength; and

a broad band ultraviolet objective configured to image the first object at the first ultraviolet wavelength and to image the second object at the second ultraviolet wavelength, wherein the objective comprises a first lens and a second lens having different dispersions, and wherein the system is configured to detect defects on the first or second object using the image of the first or second object, respectively.

38. The system of claim 37, wherein the first or second object comprises a reticle, and wherein the first or second ultraviolet wavelength is an exposure wavelength for which the reticle has been constructed.

39. The system of claim 37, wherein the objective is further configured to image the first and second objects with light scattered by the first and second objects, respectively.

40. The system of claim 37, wherein the light source comprises an excimer laser.